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The purpose of this study was to assess the effects of varying hopper duration on negative automaintenance in the pigeon. These effects were assessed in six experimental Ss by exposing them to either two-, four-, or eight-second hopper durations. A fixed trial negative contingency in which a peck's only consequence was to cancel grain for that trial was in effect at all times. Trials consisted of an eight-second illumination of a response key programmed on a VT 30-second schedule. In all conditions, the percent of trials with at least one peck remained roughly constant across all subjects. Average latencies across Ss decreased as the hopper duration increased. Individual Ss manifested this effect most clearly in the difference between the eight-second and the two shorter conditions. This effect is consistent with effects of similar manipulations done in the context of Pavlovian conditioning. An analysis of sequential dependencies within and across sessions showed that there is a tendency for the number of trials with a peck to oscillate in successive sessions. No dependencies of this sort were discovered on a within session basis. It is suggested that specific mechanisms be defined by experimenter operations as the mechanisms of behavioral control.

THE EFFECTS OF VARYING THE DURATION OF GRAIN PRESENTATION ON NEGATIVE AUTOMAINTENANCE IN THE PIGEON

by

Peter D. Balsam

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Approved by

Aaron J. Brownstein
Thesis Adviser

APPROVAL PAGE

This thesis has been approved by the following committee of the Faculty of the Graduate School at The University of North Carolina at Greensboro.

Thesis Adviser Aaron J. Brownstein

Committee Members

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CHAPTER I

INTRODUCTION

Recently, autoshaping research has focused attention on the control of skeletal behavior through stimulus-stimulus contingencies.

Brown and Jenkins (1968) demonstrated that pigeons reliably came to peck a response key when a change in the illumination of the key was shortly followed by grain presentations. Williams and Williams (1969) found that this procedure resulted in maintained pecking even when key pecks prevented the occurrence of grain. These studies suggested that the stimulus-grain pairings are an important determinant of key pecking in the autoshaping paradigm.

The importance of the specific association between key light and grain is further substantiated by the failure to get autoshaping with a backwards pairing paradigm (Brown & Jenkins, 1968), with a trials only procedure (Brown & Jenkins, 1968; Hitzing & Safar, 1970), a grain only procedure (Brown & Jenkins, 1968), or with an explicit unpaired procedure in which grain is presented only during the inter-trial interval (Hitzing & Safar, 1970). One line of research has therefore been an attempt to elucidate the relationship that must exist between grain and key light for the acquisition and maintenance of pecking.

Gamzu and Williams (1971, 1973) demonstrated that even when there was no programmed relationship between the onset of the trial stimulus and grain, a positive association between these two events was a sufficient condition for the development and maintenance of key pecking. Gamzu and Schwartz (1973) showed that high rates of pecking could be maintained by multiple schedules of response independent (VT) reinforcement only when there were differential rates of reinforcement associated with each component stimulus. This line of research then has shown that if there is a differential probability of grain presentation associated with key colors that alternate, pecking will develop and be maintained in the presence of the color with the higher probability of grain presentation.

Another procedure for exploring the stimulus-grain relationships in autoshaping was reported by Groves and Brownstein (1973) and by Groves (1973). This procedure involves varying the trial size and inter-reinforcement interval. These results indicated that the percent of trials with a peck and rate of pecking decreased with increases in the inter-reinforcement interval. In addition to this, at a given inter-reinforcement interval, it was found that pecking was an inverse function of trial duration. These results are best summarized by describing

the tendency to peck as increasing as the ratio of trial stimulus duration to inter-reinforcement interval decreases. Ricci (1973) reported results consistent with this description of effects. Subjects showed an increasing tendency to peck as the trial stimulus became temporally more contiguous with grain presentation.

Other procedures for elucidating the relationships between the essential variables in auto maintenance involve the manipulation of the trial stimulus consequence. In most studies the stimulus consequence is grain though other stimuli have been used to autoshape animals such as brain stimulation, heat, water, and electric shock (Peterson et al., 1973; Wasserman, 1973; Jenkins & Moore, 1973; Rachlin, 1969).

It has been frequently pointed out that autoshaping and Pavlovian conditioning are formally equivalent procedures. This suggests that some of the important parameters of autoshaping might be the same as those that are influential in Pavlovian conditioning. Within the latter framework quantitative variations of the UCS have generally been found to be directly related to the strength of the CR (Gantt, 1938; Bruner, 1971; Kimmel, Kimmel, & Silver, 1971; Gormezano & Moore, 1962). This type of quantitative manipulation of the stimulus consequence might therefore be expected to have an important influence on autoshaping and automaintenance.

The purpose of the present study is to gain this information by evaluating the effects of different durations of grain presentation on the acquisition of autoshaped key pecking and its negative automaintenance.

CHAPTER II

METHOD

Subjects

Six pigeons were maintained at approximately 80% of their free feeding weights throughout the course of the experiment. Two of the subjects (B-1, B-2) had a history of exposure to several automaintenance procedures. The remaining four Ss were experimentally naive.

Apparatus

The apparatus consisted of a Lehigh Valley Electronics two-key pigeon chamber measuring 30 cm X 46 cm X 45 cm. The keys were located 35 cm above the floor and 14 cm from the sides. The key on the right side of the response panel remained covered by a metal plate at all times. The other key was illuminated during trials by two GE #1829 bulbs in series with 63 Ω of fixed resistance and a 28-volt power source. The feeder aperture was located directly between the two keys and 9.5 cm above the floor. General illumination of the chamber was provided for by two unshielded GE #1829 bulbs located in the upper right corner of the response panel. These houselights remained on at all times except during feeder operation. White noise remained on at all times in an attempt to mask

extraneous sounds. Standard electro-mechanical programming equipment adjacent to the experimental chamber was used to control the experiment and record data.

Procedure

All Ss were trained to eat from the hopper in two sessions. The food magazine was raised until each S had its head in the magazine aperture for 30 seconds. The magazine was then operated on a VT 38-sec schedule. Hopper presentations were either 2, 4, or 8 seconds in duration. Each training session consisted of 5 hopper presentations of each duration. This yielded a total of 15 hopper presentations in each of the two pre-experimental sessions. The specific sequence of hopper durations was the same randomly generated order for all subjects.

On the third day and on subsequent days for the remainder of the experiment, each S was placed in the experimental chamber for sessions consisting of 40 trials. During a trial the response key was illuminated for 8 seconds. If no key pecks occurred while the key was illuminated, the key darkened at the end of a trial and grain was presented. Trials in which a key peck occurred did not differ from those previously described; however, these trials were not followed by grain presentations. Key pecks had no other programmed consequences at any time. This procedure has been termed a "fixed-trial negative contingency" (Schwartz & Williams, 1972). Trials were

scheduled by a tape programmer on an equal probability variable time schedule (Catania & Reynolds, 1968) with a mean inter-trial interval of 30 seconds.

The experimental manipulation consisted of varying the duration of grain presentations. Each condition consisted of ten successive sessions during which each S was exposed to one of the three different feeder durations. The order of exposure to each of the conditions is shown for all Ss in Table 1. Each S was exposed to each of the conditions once and then re-exposed to the initial condition.

TABLE 1

SEQUENCE OF EXPOSURE TO DIFFERENT HOPPER DURATIONS

All conditions were in effect for 10 consecutive days. A fixed trial negative contingency was in effect at all times with trials occurring on a VT 30-second schedule.

Order of Exposure	I	II	III	IV
A-9	2	8	4	2
A-10	2	4	8	2
A-11	8	4	2	8
A-12	8	2	4	8
B-1	4	2	8	4
B-2	4	8	2	4

CHAPTER III

RESULTS

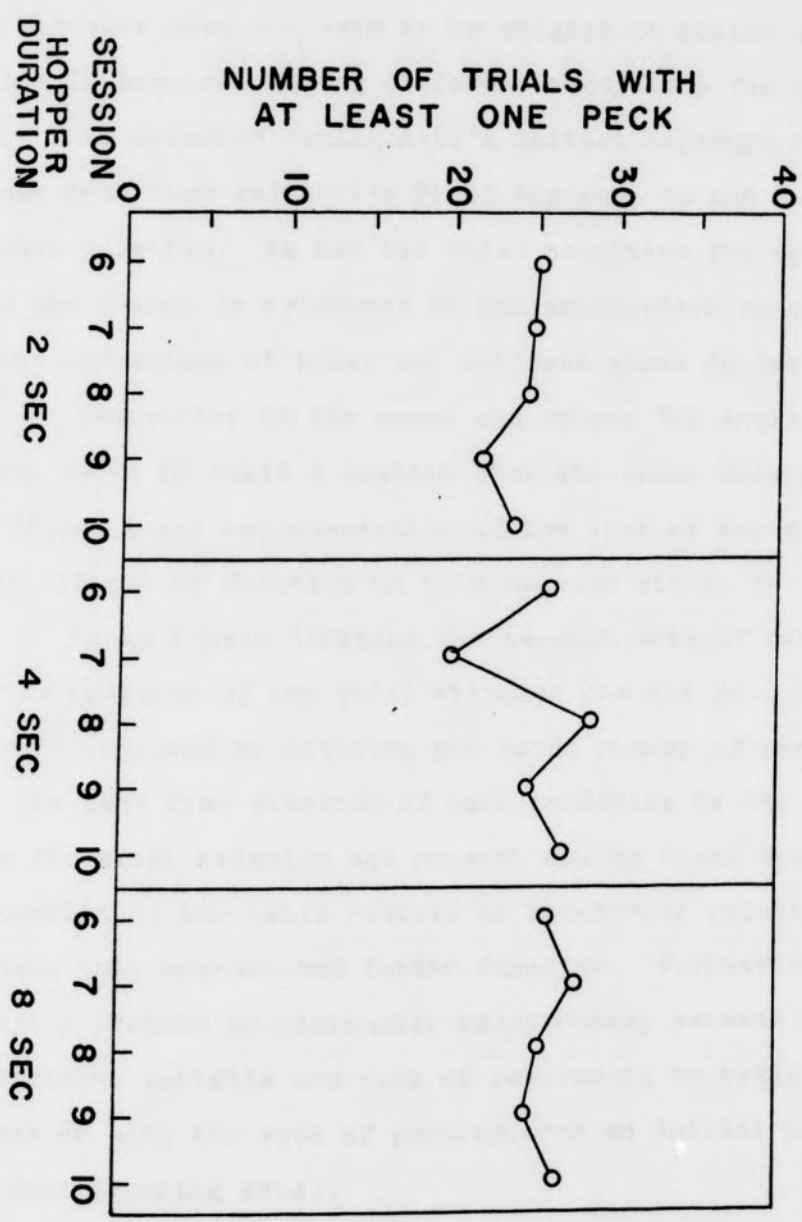
The naive birds initially exposed to a 2-sec hopper duration did not differ from those exposed to 8-sec presentations in their acquisition of the key pecking response. A-9's initial peck occurred on the first trial, A-10's on the 13th, A-11's on the 8th, and A-12's on the 50th trial. The latter S did not eat from the hopper until the 21st trial. A-12's hopper "shyness" might account for the difference between the trial of his first peck and the other three Ss.

The number of trials with at least one response averaged across Ss for each of the last five days of each condition is shown in Figure 1. The maximum number of trials with a peck is 40. Therefore, Ss pecked on an average of about 62% of the trials across all conditions. It is clear that there were no systematic changes in the group data as a function of the independent variable. Each point represents the average across all six Ss for that particular session during their initial exposure to a particular hopper duration. The reversal determinations are not included because two Ss (A-10, A-11) had substantially fewer trials with a peck during this phase than they

FIGURE 1

MEAN NUMBER OF TRIALS WITH AT LEAST ONE RESPONSE

The mean number of trials with at least one response averaged across all Ss. The last five days' exposure to each condition during the initial determinations is shown here for the three hopper durations.


NUMBER OF TRIALS WITH AT LEAST ONE PECK
0
10
20
30
40
SESSION
HOPPER DURATION
6 7 8 9 10
2 SEC
6 7 8 9 10
4 SEC
6 7 8 9 10
8 SEC

did during earlier phases of the experiment. This change in behavior does not seem to be related to hopper duration, since it occurred during different conditions for the two Ss. This occurred during A-10's initial exposure to the 8-sec condition and A-11's first exposure to the 2-sec feeder duration. It was the third condition for both Ss and the change is evidenced in the appropriate condition means and ranges of these two subjects shown in Table 2.

Inspection of the means and ranges for individual birds shown in Table 2 reveals that the group data presented in Figure 1 are representative of the lack of any consistent effects of duration on this measure within Ss.

Table 2 also contains the average rate of responding in the presence of the trial stimulus for all Ss. This rate is computed by dividing the total number of responses for the last five sessions of each condition by the total time the trial stimulus was present during these sessions. Inspection of the table reveals no conclusive relationships between this measure and feeder duration. Further rate analyses yielded no systematic relationship between the independent variable and rate of responding on trials with a peck or with the rate of pecking once an initial peck was made (running rate).

The third column of Table 2 shows one measure that reflected a sensitivity to the extreme hopper durations. The average latency to the first peck on trials with a peck

TABLE 2

NUMBER OF, RATE OF, AND LATENCY OF PECKS
FOR INDIVIDUAL SUBJECTS

The mean number of trials with at least one peck, the average rate of responding and the average latency on trials with a peck for the last five days of each condition are shown for each S. The ranges of each measure in each condition appear below their respective means.

	2-Sec		
	# Trials with Peck	Rate	Latency
A-9	35.8	20.22	.067
	34-38	13.31-24.58	.059-.076
A-10	17.2	5.14	.079
	13-24	3.51- 8.69	.062-.088
A-11	19.4	7.21	.064
	2-36	0.37-17.74	.052-.077
A-12	23.8	8.32	.090
	18-29	4.81-11.65	.084-.096
B-1	28.4	10.09	.079
	19-31	7.03-13.31	.071-.087
B-2	18.6	5.95	.082
	16-31	1.48-10.72	.047-.101
Group	23.87	9.49	.077
	2-38	.37-24.58	.047-.101

	4-Sec		
	# Trials with Peck	Rate	Latency
A-9	37.6	22.37	.069
	34-40	17.37-32.72	.057-.084
A-10	24.6	7.95	.081
	17-32	4.44-12.19	.075-.089
A-11	30.4	14.45	.061
	22-36	6.65-21.07	.040-.073
A-12	11.6	4.14	.089
	4-18	3.14-5.36	.077-.106
B-1	19-8	5.95	.084
	7-29	1.48-8.69	.072-.106
B-2	26.75	12.38	.061
	20-32	5.55-21.26	.047-.067
Group	25.07	11.17	.075
	7-40	1.48-32.72	.047-.106

	8-Sec		
	# Trials with Peck	Rate	Latency
A-9	37.2	25.66	.055
	35-39	20.70-38.26	.050-.068
A-10	7.6	1.74	.060
	4-15	0.74-3.51	.043-.079
A-11	35.6	17.6	.058
	34-38	16.27-19.59	.049-.064
A-12	18.4	5.06	.068
	9-22	2.03-6.28	.064-.075
B-1	33.2	13.75	.074
	29-35	11.83-16.45	.057-.082
B-2	23.6	9.09	.091
	21-26	7.39-10.54	.084-.099
Group	25.93	12.15	.068
	9-35	0.74-38.26	.043-.099

	Reversal		
	# Trials with Peck	Rate	Latency
(2-Sec) A-9	31.8	14.23	.069
	28-36	8.69-21.8	.059-.075
(2-Sec) A-10	11.6	2.59	.071
	6-18	4.07-1.11	.046-.088
(8-Sec) A-11	3	.67	.047
	2-4	.37-1.11	.025-.085
(8-Sec) A-12	25.8	10.49	.102
	21-29	7.02-14.42	.094-.109
(2-Sec) B-1	36.4	19.89	.061
	35-39	17.19-27.35	.051-.077
(2-Sec) B-2	25.2	10.68	.080
	19-34	6.47-20.15	.061-.088

is longer during the 2- and 4-sec conditions than the 8-sec condition in five out of the six Ss. There is no consistent difference exhibited in this measure when comparing the 2- and 4-sec determinations within a subject.

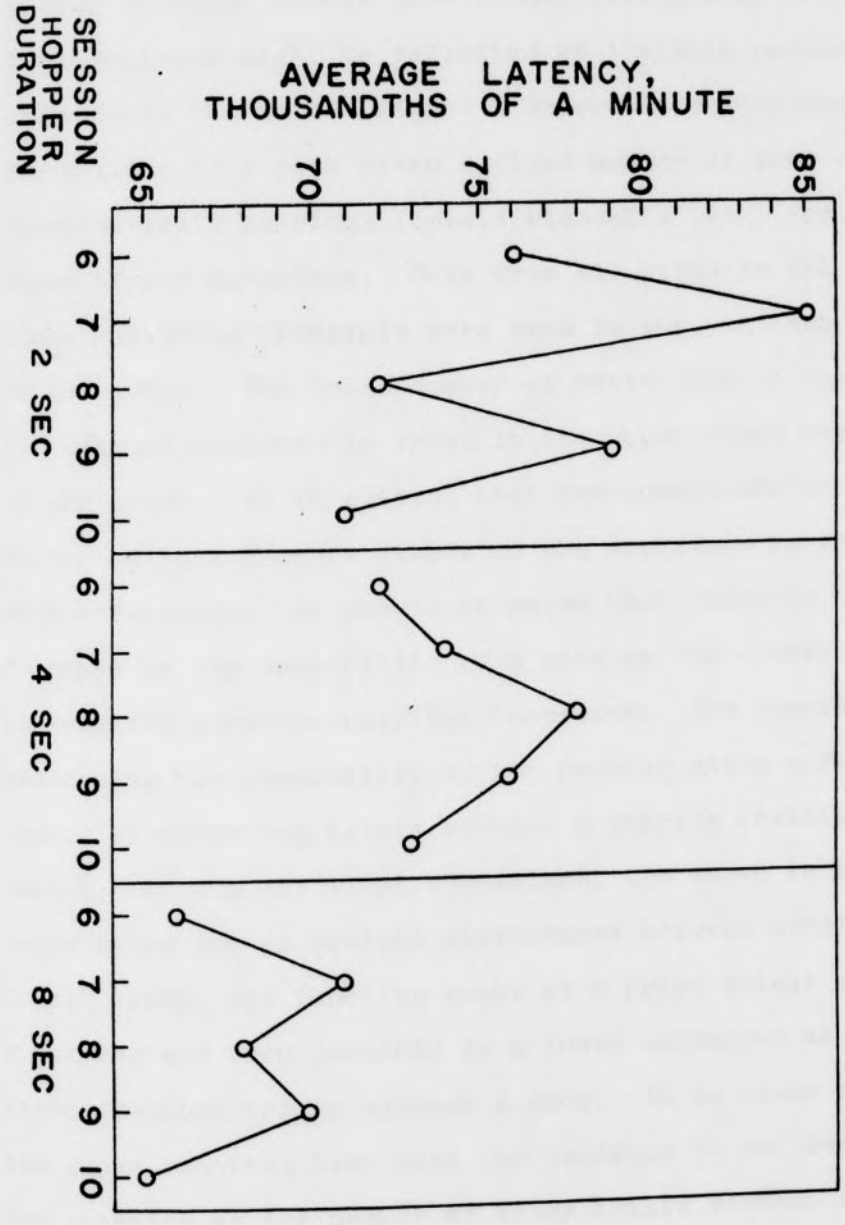
This measure rather than the overall average latency is presented to facilitate comparison between birds. The overall measure would reflect differences in the probability of pecking on a trial as well as latency changes. It is clear that since individual subjects show little change in the probability of a peck across conditions, the order of within S effects is not affected by the choice of either measure of latency. Figure 2 shows the session by session averages of all six subjects in each condition. The group function shows an orderly decrease in latency on trials with a peck as the duration of the grain presentation increases. Again it should be noted that only the difference between the shorter conditions and 8-sec grouped data seems to be representative of most of the Ss. In seconds, the duration of the trial stimulus is approximately 8 sec long and the change in latency between the 2- and 8-sec conditions ranges from about 1/3- to 1 1/3-sec decrease in the latency with the average difference equal to a little more than 1/2 sec.

One additional point about the latencies is that in all conditions the latencies are equal to or slightly longer than half the trial stimulus duration (.0675 min., or approximately 4 sec).

FIGURE 2

LATENCY ON TRIALS WITH A PECK

Latency on trials with a peck averaged across Ss for the last five days of each initial exposure to a particular hopper duration.


AVERAGE LATENCY,
THOUSANDTHS OF A MINUTE
65
70
75
80
85
SESSION
HOPPER
DURATION
6
7
8
9
10
2 SEC
4 SEC
8 SEC

Though the overall probability of a peck remains roughly constant across conditions, differences between the conditions might be reflected on a within session analysis of the data. Figure 3 shows the conditional probability of a peck given a fixed number of consecutive stimulus-grain pairings (trials without a peck) for all three hopper durations. Data from all birds in all conditions including reversals were used to compute each point on the graph. The total number of pecks used to compute the measure depicted is shown in the upper right corner of the graph. It is evident that the conditions do not differ on this measure either in the magnitude or form of the function. It should be noted that there is no increase in the probability of a peck as the number of consecutive previous pairings increases. The functions describing the probability of not pecking given a fixed number of preceding trials without a pairing (trials with pecks), for the different conditions, are shown in Figure 4. Again there are no obvious differences between conditions. In all cases, the function peaks at 0 prior trials without a pairing and then declines to a lower asymptote at about three previous trials without a peck. It is clear over the range reported here that the tendency to not peck does not increase as the number of prior trials without a pairing increases.

FIGURE 3

CONDITIONAL PROBABILITY GIVEN n PRIOR SUCCESSIVE PAIRINGS

The conditional probability of a peck, given n prior successive pairings for three hopper durations. The total number of pecks used to compute each point is shown in the upper right portion of the graph. Open points were computed from less than 15 opportunities to peck.

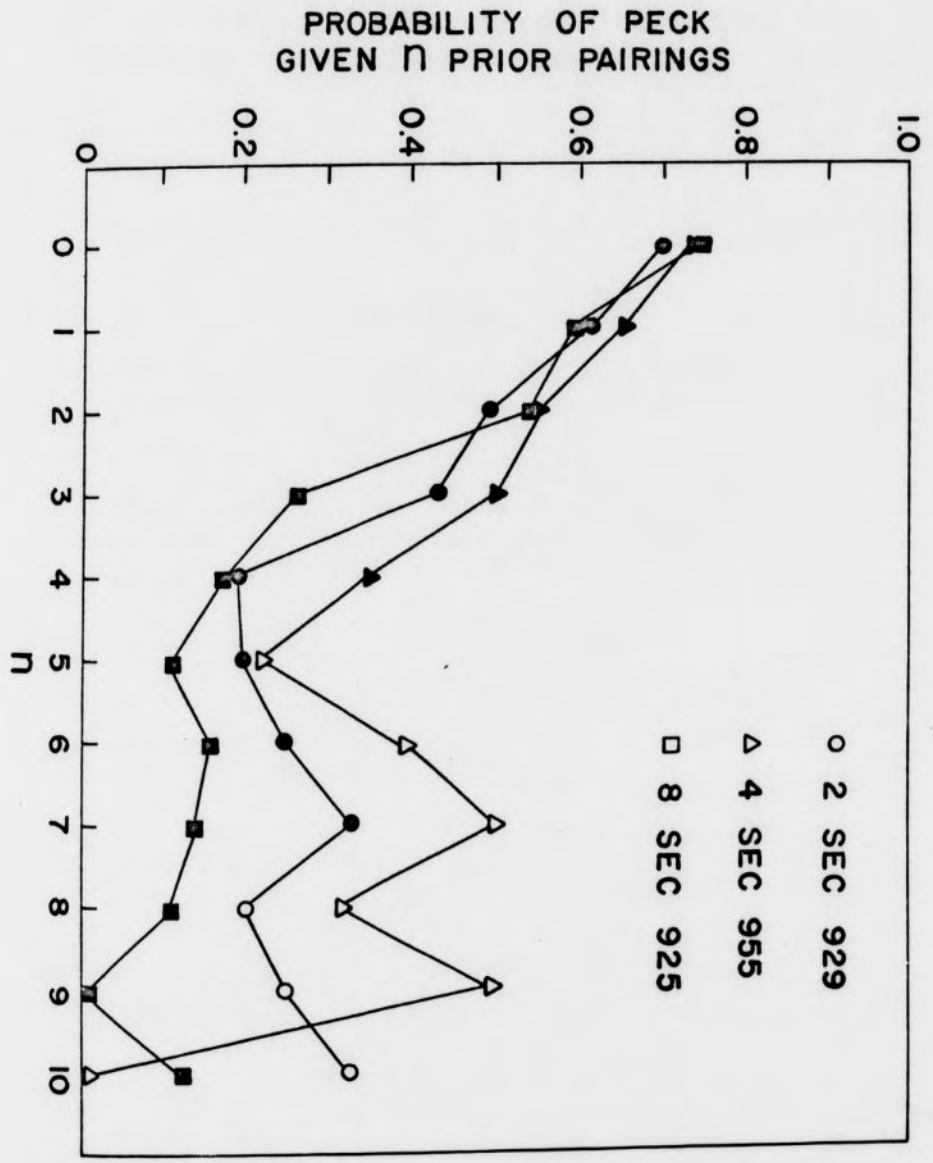
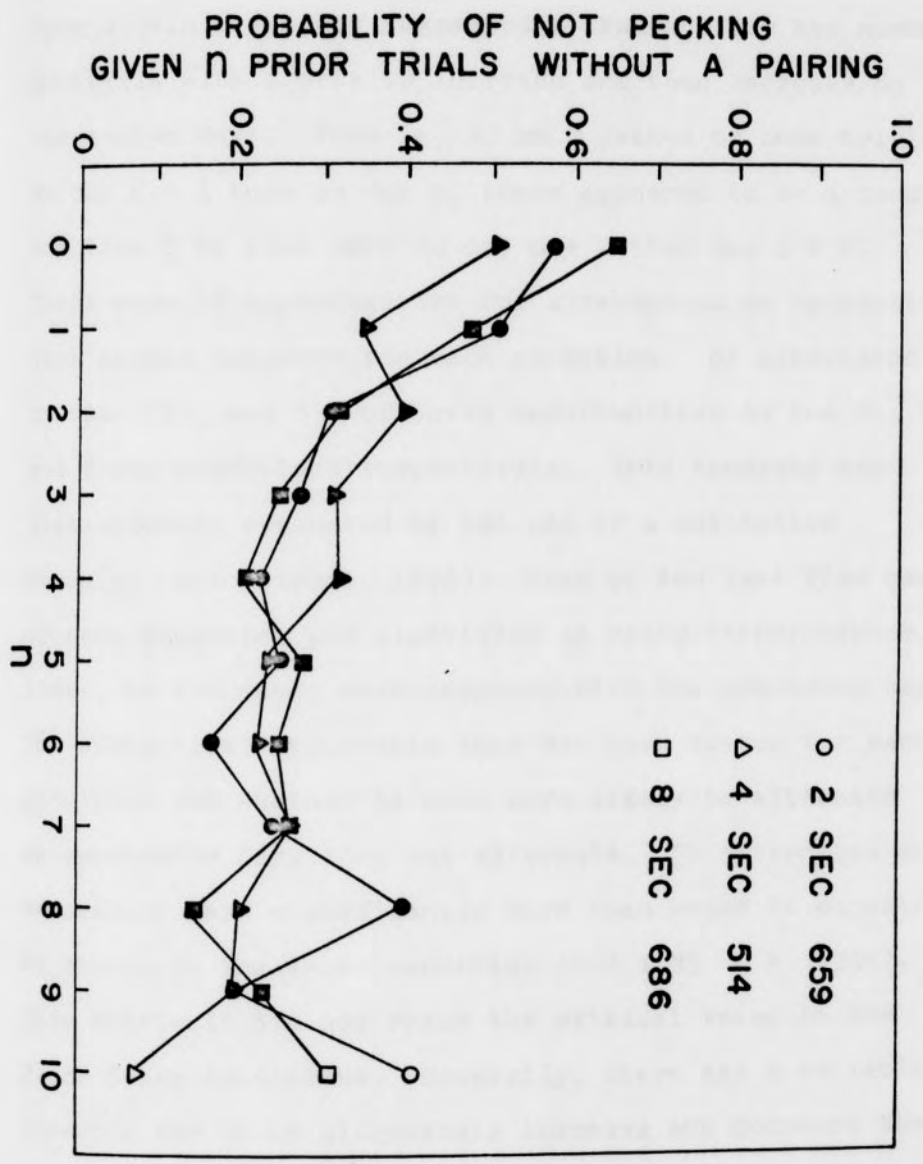

PROBABILITY OF PECK
GIVEN n PRIOR PAIRINGS
0
0.2
0.4
0.6
0.8
1.0
0 1 2 3 4 5 6 7 8 9 10
n
○ 2 SEC 929
△ 4 SEC 955
□ 8 SEC 925

FIGURE 4

CONDITIONAL PROBABILITY OF NOT PECKING GIVEN n PRIOR SUCCESSIVE TRIALS WITHOUT A PAIRING

The total number of trials without pecks used to compute each point is shown in the upper right portion of the graph. Open points were computed from less than 15 opportunities not to peck.


PROBABILITY OF NOT PECKING
GIVEN n PRIOR TRIALS WITHOUT A PAIRING
0
0.2
0.4
0.6
0.8
1.0
n
0
1
2
3
4
5
6
7
8
9
10
○ 2 SEC 659
△ 4 SEC 514
□ 8 SEC 686

Although the conditional probabilities do not suggest a waxing and waning pattern of behavior, inspection of the data within a subject suggested a tendency for the number of trials with a peck to increase and then decrease on successive days. That is, if an S pecked on more trials on day n + 1 than on day n, there appeared to be a tendency for that S to peck less on day n + 2 than day n + 1. There were 32 opportunities for alternation on successive days across subjects for each condition. Ss alternated on 61%, 71%, and 63% of these opportunities in the 2-, 4-, and 8-sec conditions respectively. This tendency was statistically evaluated by the use of a one-tailed binomial test (Siegal, 1956). Each of the last five days of each condition was classified as being either higher, lower, or the same, when compared with the preceding day. The statistical hypothesis that was then tested for each condition was whether Ss were more likely to alternate on successive days than not alternate. Ss alternated on successive days significantly more than would be expected by chance in the 4-sec condition ($Z = 1.83$ $p = .0336$). This statistic did not reach the critical value in the 2- or 8-sec conditions. Generally, there was a reliable tendency for Ss to alternately increase and decrease the number of trials with a peck on successive days, though this was only statistically significant in the 4-sec condition. It should be noted that pooling these data

across Ss may make the appropriateness of this test questionable, since observations must be assumed to be independent and of equal probability across and within subjects.

CHAPTER IV

DISCUSSION

Autoshaping and Pavlovian Conditioning

The primary conclusion of this experiment is that the latency of key pecks in negative automaintenance is inversely related to the duration of grain presentations. This statement is based on the data that comprise the function depicted in Figure 2. These data indicate a difference between the 8-sec condition and the two shorter hopper durations. The unsystematic changes in this measure during the two shorter conditions may be a result of method of stimulus consequence presentation employed in the present study. It is not clear at this time what the "effective" dimensions of the grain may be in inducing pecking. Is the sight of grain, the feel, the smell, the taste, in the beak or in the crop the "effective" stimulus consequence? If the effective stimulus requires the animal to be near the hopper, it is clear that the procedure employed here permits substantial variability in the duration of the "effective" grain presentation. If this variability is constant in each condition, the distributions of obtained grain durations will overlap more in the 2- and 4-sec conditions than either of these distributions will with

the one obtained at the 8-sec feeder duration. One procedural modification to assess this possibility would be to time grain presentation from the time the animal inserts its head in the hopper orifice.

The relationship between the duration of grain presentation and latencies compares to the effects of varying UCS magnitude in Pavlovian conditioning. The most comparable data using a food UCS showed that both the intensity (total amount of parotid secretion) and the latent period were related to the quantity of food delivered (Gantt, 1938). The latencies in the present study conform to these results though other aspects of the animals' behavior do not. Differences in effects may be due to such differences as the distinction between delivery and presentation of reinforcement, to the nature of the response used, or to the effects of a negative response contingency in the experiment reported here. Studies are currently being conducted in our laboratory to assess the latter possibility.

The findings of this experiment should be added to the data that evaluate the functional similarities and differences of autoshaping and Pavlovian conditioning (Williams & Williams, 1969; Gamzu & Williams, 1971; Jenkins & Moore, 1973). The current results point out the problems of identifying different kinds of learning processes by outcomes alone. In situations where some dependent

changes are similar and some different, we can restrict the effects of a manipulation to the measures that show consistent changes. This forces us to then search for new ways of viewing the situation and seeing traditional paradigms as not being examples of unitary mechanisms, but rather as a situation where a variety of behavioral mechanisms may be interacting. (See Staddon and Simmelhag, 1971.) Utilizing this general strategy to analyze situations may resolve inconsistencies in the effects of certain variables.

For example, it is clear that magnitude of reinforcement does have effects on behavior controlled by stimulus-reinforcer relationships and this may have implications for other situations. Perhaps the different stimulus-reinforcer relationships that exist in discrete trial procedures and free operant situations account for the differing effects of varying reinforcer magnitude in the two situations. Pubols (1960) in a review of literature relevant to the former procedure concluded that varying reinforcer magnitude has an effect on asymptotic performance levels. Manipulation of reinforcer magnitude in the latter situation, however, has yielded weak (Jenkins & Clayton, 1949), transient (Kessey & Kling, 1961), or nonexistent (Catania, 1963) effects.

Sequential Dependencies

A second aspect of the results that deserve mention is the analyses of sequential dependencies. It is clear from previous work that the effectiveness of the key light in controlling maintained pecking depends on its differential pairing with grain (Brown & Jenkins, 1968; Hitzing & Safar, 1970; Gamzu & Williams, 1971, 1973). If the strength of the behavior at any given point in time is related quantitatively to the number of prior pairings within a session, then the probability functions depicted in Figures 3 and 4 should have taken a different form. The probability of a peck should increase as the number of prior pairings increases. Similarly, the probability of not pecking should increase as the number of trials without a pairing increases. Since this is not the case, the keylight must derive its effectiveness over some greater period of time. The importance of preceding pairings may average across an entire session and be responsible for the tendency of animals to vary their output in a waxing and waning manner across sessions. For example, if an animal pecks on a large proportion of trials in a session, there will be few pairings and in the following session the animal seems to be less likely to peck; this in turn results in more pairings and an increased tendency to peck on the following day. In general, the behavior on day n depends on the animal's behavior on day n-1 and perhaps this is due to successive changes in pairings.

Additional data were collected for one subject (A-9) under the same circumstances except that sessions lasted for 90 trials instead of 40. The form of the within session probability function was identical to the ones reported here. Hence, the lack of within session dependency does not appear to be unique to a 40-trial session. On days in which Ss made fewer pecks, there were more hopper presentations. This may have resulted in a higher body weight in the subsequent session. However, in other studies in this laboratory much greater variations in body weight than were exhibited by the subjects in this study on successive days were shown to have no effect on the number of trials with a peck. Thus it is unlikely that day to day fluctuations in body weight could account for the across session dependencies.

This across session effect can be viewed as an example of the pigeons' sensitivity to rates of events (Hernstein, 1969, 1970; Baum, 1973). Perhaps large stimulus changes, such as the entrance into and removal from the experimental chamber, determine the time over which the animal computes rates of events. Clearly, more research on the variables that influence this averaging process is needed in a variety of experimental settings.

Acquisition

There was no relationship between hopper duration and the trial with the first peck in the four naive subjects

used in this study. This study was designed with the hope of assessing the effects of different hopper durations on pecking controlled by stimulus-grain pairings. For this reason, each S's history prior to experimental pairings was identical. However, there is reason to believe that other relations between grain and key light, like the hopper training followed by keylight in the present study, may be a sufficient condition for the development though not maintenance of key pecking. Hitzing and Safar (1970) showed that exposure to food presentations and subsequently to an aperiodically lit key in successive sessions was a sufficient condition for the development of key pecking. It is obvious that at least the first peck of A-9, which occurred prior to any pairings, must have been due to factors of this sort. Furthermore, there is no reason to assume that these factors could not be at least partially responsible for the early behavior of other Ss. Therefore, the hopper training procedures used in the current study may have obscured the effects that varying feeder duration might have on acquisition.

General Implications

It should be noted again that the effects of varying the duration of hopper presentation on behavior controlled by stimulus-grain relationships is only assessed here in the context of a negative response reinforcer relationship. Schwartz and Williams (1972) have suggested that the

procedures used in the present study be viewed as an interaction of response-reinforcer and stimulus-reinforcer mechanisms that control mutually exclusive classes of behavior. The stimulus-reinforcer relationship controls key pecking and the response-reinforcer relationship controls a class of non-key peck behaviors. Presumably, the former relationship dominates the situation and substantial key pecking is maintained. When looking at the experiment in this way, increasing amount seems to selectively affect the stimulus-reinforcer relationship more than the response-reinforcer relationship. This is evidenced by the decreased latency with longer hopper presentations. Longer latencies, fewer trials with a peck, or lower rates might all have represented an increase in control by the response-reinforcer relations with increasing feeder durations. Hence the conclusion drawn from this study is that the manipulation had a relatively greater effect on stimulus-reinforcer than on response-reinforcer control. This may be a reflection of generally weak control by response-stimulus relations in the context of a negative response-reinforcer contingency (Silberberg, 1971).

Within this framework, the sudden decrease in key pecking demonstrated by Ss A-10 and A-11 may be viewed as a switch to the relative dominance of the two mechanisms. The factors that might be responsible for this switch are not clear at this time.

One general consequence of this view is that there are no situations in which only response-reinforcer or stimulus-reinforcer relationships are operative if our theories include the effects of unprogrammed relations (adventitious reinforcement of responses or stimuli). Acceptance of this view requires that the effects of any variable on a behavior be assessed in a multi-dimensional space defined by the possible mechanisms operative in controlling the behavior. For example, the effects of amount of reinforcement on key pecking are only understood when the manipulation is carried out under different response-reinforcer and stimulus-reinforcer contingencies. The aim of this analysis is a specification of the changes in relative control of different behavioral mechanisms as the independent manipulation is carried out. In our example, if we find that across a variety of response-reinforcer relations that latency changes in an identical way to the changes reported here, we are likely to conclude that the mechanism of action for amount of reinforcement on latency is through stimulus-reinforcer relations. This will be a particularly strong conclusion if parallel functions are obtained at other points on the stimulus-reinforcer dimension. More complicated outcomes are easily imaginable, both in the kind of relationships existing between mechanisms and a particular aspect of behavior and in the relationships operative in controlling different

aspects of behavior (e.g., percent of trials with a peck may be controlled by different mechanisms than latency).

One of the greatest challenges to this position is the current inability to quantitatively scale response-reinforcer and stimulus-reinforcer dimensions independent of their effects on behavior. This is not a new problem for behavior theory and there have been several attempts at mathematically describing these relations (Skinner, 1958; Findley, 1962; Schoenfeld et al., 1972; Snapper, Knapp, & Kushner, 1972). Perhaps concepts from information theory (Bloomfield, 1972) and/or notions like relative proximity (Jenkins, 1970; Staddon & Simmelhag, 1971; Staddon, 1972) will help in the quantification of these dimensions.

CHAPTER V

SUMMARY

The purpose of this study was to assess the effects of varying hopper duration on negative automaintenance in the pigeon. These effects were assessed in six experimental Ss by exposing them to either two-, four-, or eight-second hopper durations. A fixed trial negative contingency in which a peck's only consequence was to cancel grain for that trial was in effect at all times. Trials consisted of an eight-second illumination of a response key programmed on a VT 30-second schedule. In all conditions, the percent of trials with at least one peck remained roughly constant across all subjects. Average latencies across Ss decreased as the hopper duration increased. Individual Ss manifested this effect most clearly in the difference between the eight-second and the two shorter conditions. This effect is consistent with effects of similar manipulations done in the context of Pavlovian conditioning. An analysis of sequential dependencies within and across sessions showed that there is a tendency for the number of trials with a peck to oscillate in successive sessions. No dependencies of this sort were discovered on a within-session basis. It is suggested that specific mechanisms be defined

by experimenter operations as the mechanisms of behavioral control.

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